Disaster Response Flood Recovery Data
for
Sandoval County, New Mexico & Incorporated Areas

FEDERAL EMERGENCY MANAGEMENT AGENCY

Region VI

EMT-2002-CO-0052

Task Order 35

January 7, 2008

DISASTER RESPONSE FLOOD RECOVERY DATA
FINAL REPORT

For

Sandoval County, New Mexico

SUBMITTED BY: MAPVI

DATE SUBMITTED: January 7, 2008

Table of Contents

List of Tables

List of Figures

Appendices

Appendix A – Field Reconnaissance

Appendix B – Hydrology

Appendix C – Hydraulics

Appendix D – Flood Recovery Data

Appendix E – QA Forms

- Technical Audit Report and Audit Finding Report Forms
- Independent Technical Review Comment Form
- Detail Check Review Comment Forms
    - Review of Cross-Sections
    - HEC-RAS Hydraulic Model and Floodplain
    - TSDN Report and Digital Data

Appendix F – Supplemental Info

1. Introduction

MAPVI is under contract to FEMA to provide the Disaster Response Flood Recovery Data for Sandoval County, New Mexico in response to the flooding that occurred in August 2006. As part of the Flood Recovery Tools, this Technical Support Data Notebook (TSDN) is intended to clearly define the scope of work, methodologies for modeling, any exceptions to the standards outlined in the scope of work, and to summarize the final results.

This TSDN provides a review of the development and results of Flood Recovery Tools including Field Reconnaissance, Topographic Data, Hydrology, Hydraulics, and Flood Recovery Data. This TSDN has been reviewed and approved in accordance with the Quality Assurance Plan (QAP). Copies of all QA forms are provided in Appendix E.

2. Scope of Work

MAPVI has been tasked to produce digital and hard copy Advisory Flood Recovery Tools, which consist of Advisory Flood Recovery Maps, Floodplain Elevation Data Tables, and Advisory Flood Recovery Profiles along with a TSDN report summarizing the findings of and methodologies that were used for development of these tools. Flood Recovery Tools will be available through the FEMA Flood Hazard Mapping website for interested parties.

Collection and assessment of flood data and preparation of flood recovery maps are activities outside of FEMA's normal flood hazard mapping operations. These activities must take place in the immediate aftermath of a disaster. When a flood occurs, valuable data become available that enables FEMA and its Contractors to reassess the estimates of flood risk. Also, rebuilding efforts begin within a short period after the disaster, and timely updated flood risk data are necessary to ensure that the rebuilding will protect properties from future flooding disasters. The new data needs to be evaluated and, if necessary, incorporated into new engineering analyses. Appropriate hazard identification tools, such as flood recovery maps, must be produced quickly. In some cases, there may not be any detailed flood mapping at all, and flood recovery maps may be the only detailed guidance to assist the State and community in planning and managing rebuilding efforts.

The Flood Recovery Tools are developed using an Approximate Study with More Detail. This type of study involves refining effective A zones to provide unpublished flood recovery data for the community to use in floodplain management. An Approximate Study with More Detail requires analysis of only the 1-percent-annual-chance-storm event. The Advisory Flood Recovery Maps produced depict only the 1-percent-annual-chance floodplain boundaries. The Floodplain Elevation Data Tables provide flood elevations and flow velocities. The Advisory Flood Recovery Maps, Floodplain Elevation Data Tables, and Advisory Flood Recovery Profiles can be found in Appendix D.

Changes to the study stream limits are detailed in two Special Problem Reports, which can be found in Appendix F.

MAPVI will perform hydrologic and hydraulic studies to establish flood recovery data for the flooding sources listed in Table 1 in order to assist in proper floodplain management and redevelopment.

Table 1 – Study Reach Names

Study Reach Name	Stream Identifier
Arroyo de los Montoyas	MA

Field Survey and Reconnaissance

MAPVI will conduct field reconnaissance for the flooding sources to be studied shown in Table 1. The task will include obtaining the physical dimensions of hydraulic and flood control structures and documenting stream conditions.

Topographic Data

MAPVI shall use a terrain model built for the FIRM and FIS Update for Sandoval County and Incorporated Areas, New Mexico EMT 2002-CO-0052, Task Order 15 for the flooding sources. This terrain model will be used to support the hydrologic and hydraulic analyses and floodplain delineation.

Hydrologic Analysis

MAPVI shall develop the peak 1-percent-annual-chance flood discharge using the appropriate United States Geological Survey (USGS) regression equations. MAPVI shall develop drainage from USGS 30-Meter digital elevation model information. General guidance for performing the hydrologic modeling can be found in Volume 1 and Appendix C of the *Guidelines and Specifications for Flood Hazard Mapping Partners (G&S*), as amended.

For flooding sources with dams upstream of the study reach, MAPVI will estimate the outflow from the dam by determining the hydraulic capacity of the outlet structure assuming the maximum headwater at the top of the dam. MAPVI will not calculate stage-storage discharge or route the 1-percent-annual-chance flood through the dam outlet works.

Hydraulic Analysis

MAPVI shall develop the cross sections to be used in the hydraulic model from USGS 7.5-minute series quadrangle maps, unless better topographic or survey data are available. General guidance for performing the hydraulic modeling can be found in Volume 1 and Appendix C of the *G&S*, as amended. Additionally, water surface elevations and flood velocities shall be determined as part of this hydraulic analysis.

The limits of each study reach are described in. Figure 1, located at the end of this report, provides a graphical representation of the study stream analysis limits.

Table 2 – Study Reach Analysis Limits

Study Reach Name	Reach Length (miles)	Downstream Limit of Study	Upstream Limit of Study
Arroyo de los Montoyas	1.80	5,540 feet above the Harvey C. Jones Channel Inlet	Toe of Montoyas Arroyo Sportsplex Dam

Flood Recovery Data

MAPVI shall produce flood recovery data using the best topographic data available on a suitable base map. MAPVI shall ensure all digital mapping files are produced in accordance with the requirements documented in the *G&S*, as amended.

Deliverables

MAPVI will include the deliverables of this task in the TSDN for the Flood Frequency Determination. The deliverables shall include:

- Digital and hard copy flood recovery maps depicting the 1-percent-annual-chance floodplain boundaries generated from the Approximate Study.
- Unpublished flood profiles.
- Tabulated peak discharge, water surface elevations, and velocities.
- A report summarizing the findings of and methodologies for the flood recovery data tools task.
- The report will be available through the FEMA Flood Hazard Mapping website for interested parties.

Standards

All work under this task order will adhere to the *G&S* as identified in the IDIQ contract.

3. Field Reconnaissance

Field Reconnaissance for Task Order 35 was conducted on all study reaches in Sandoval County, New Mexico. During the week of July 31, 2007, MAPVI personnel visited the identified channel network. Detailed field notes and digital photographs were collected in order to characterize the physical structure and condition of each location. Field reconnaissance notes, photographs, and structure location maps are included in Appendix A.

Along the channel, stream conditions were documented at typical cross sections and the types and numbers of hydraulic structures were identified. At each structure, physical dimensions and conditions were recorded, as well as other parameters needed for the hydrologic and hydraulic modeling. The team specifically looked for any indication of maintenance or lack thereof, as well as damage to the channel and structures.

The Approximate Study with More Detail Survey for structures were measured per Watershed Concepts, Inc. Watershed Information System (WISE) Survey Manual Version 3.7 (July 2004)

using measuring tapes and hand levels. Only one structure (a culvert) was identified during field reconnaissance and was subsequently surveyed.

3.1. Culvert Surveys

For Approximate Studies with More Detail, culvert measurements include the following.

- Height, width, length, number and type of culverts.
- Relative elevations of the culvert invert, the roadway, and the right and left channel banks.
- Top and bottom widths of the channel.

3.2. Bridge Surveys

For Approximate Studies with More Detail, bridge measurements include the following.

- Height, length, and deck thickness of the bridge.
- At the bridge, the width at the top of the channel and the toe of the slope.
- Number of piers and the diameter of each pier.
- Relative elevations of the channel invert, the roadway, and the right and left channel banks.
- Channel top and bottom widths at a representative location outside any transition due to the bridge.

Information regarding structures surveyed can be found in Appendix A.

Bridge surveys were not performed, as there are no bridges present along our study reaches.

3.3. Dam and Weir Surveys

Dam and weir surveys were not performed, as there are no dams or weirs present along our study reaches.

4. Topographic Data

The City of Rio Rancho provided MAPVI with topographic information for the 2006 countywide FIRM and FIS update for Sandoval County and Incorporated Areas, New Mexico. The topographic data provided was determined to have a 4-foot contour interval equivalence. This data was used to create a Triangulated Irregular Network (TIN) in ESRI format for the creation of the hydraulic model and the automated floodplain delineation. The TIN developed under Task Order 15 was used to create the terrain model for this Disaster Response.

5. Hydrology

Hydrologic analyses were completed for the drainage area of the flooding source identified in the contract task order (Figure 1). The peak flood discharge was calculated based on the recurrence interval identified in the contract task order for annual chance storms. The flood discharge was used for the subsequent hydraulic analyses of the subject flooding source. The stream reach

studied as part of the development of Flood Recovery Tools is shown in Table 1. The upstream and downstream limits of the stream reach are described in Table 2.

Based on limited historical analysis available for the restudy areas, MAPVI reviewed the *G&S* Section C1.2.1, Sub-Section Choice of Methodology for applicable methods to use for hydrologic analysis. The USGS regression equations are recommended for estimating base flood discharges if a flow hydrograph is not needed and if the regression equations are applicable. Regression equations were not applicable for the Sandoval County study reach.

The Arroyo de los Montoyas study reach, which is under the jurisdiction of Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA), is located just downstream of the newly constructed Montoyas Arroyo Sportsplex Dam. In order to be consistent with the methodology used by SSCAFCA and to account for the anticipated flow change occurring with construction of the dam, the 1-percent-annual-chance flood discharge determined by SSCAFCA at the downstream limit of the study reach was used.

The discharge was compared to the preliminary Flood Insurance Study (FIS) for Sandoval County (FEMA, 2008). Table 3 compares the discharge published in the preliminary FIS to the discharge obtained from SSCAFCA.

Table 3 – Discharge Comparison Table

Flooding Source	Location	Restudy	
			Effective FIS
		Cumulative Drainage Area (sq. miles)	1-percent-Annual-Chance Peak Flow Rate (cfs)
Arroyo de los Montoyas	Inlet to Harvey C. Jones Diversion Channel	52.69	3,639*
		52.58	5,542

*Flow rate obtained from Addendum No. 1 to Montoyas Arroyo Watershed Management Plan (SSCAFCA, 2004).

6. Hydraulics

Arroyos de los Montoyas was modeled in accordance with the *G&S*. The Hydrologic Engineering Center's - River Analysis System (HEC-RAS) software, Version 3.1.3, developed by the U.S. Army Corps of Engineers (USACE), was used to model the study reach within Sandoval County. HEC-GeoRAS, version 4.0, also created by the USACE, was utilized to automate the creation of the HEC-RAS modeling for the study reach. The hydraulic model is included in Appendix D.

Historical data, such as high water marks, were not available for model calibration. Flood profiles depicting water surface elevations from the preliminary FIS report for Sandoval County were used. Because the downstream end of the study reach ties into the Arroyo de los Montoyas

AE zone, the preliminary FIS data was used to determine the downstream starting water surface elevation.

6.1. Cross-Sections

Contour data (2-foot interval) provided by the City of Rio Rancho and field reconnaissance data were used to obtain all cross-section information. Cross sections were placed in accordance with the *G&S* and the HEC-RAS manual with the goal of approximately 500-foot spacing. Cross-sections were placed at bridges and culverts and each was categorized as a Top of Road (TOR) cross-section. Additionally, a natural channel cross-section was placed upstream and downstream of each structure.

Cross sections were placed in accordance with the *G&S* and the HEC-RAS manual. Cross-sections were placed at bridges and culverts and each was categorized as a Top of Road (TOR) cross-section. Additionally, a natural channel cross-section was placed upstream and downstream of each structure.

6.2. Critical Depth

The Approximate Study with More Detail model was run at subcritical depth as per the *G&S*. Where the model indicated critical depth or supercritical depth, the critical depth results were reported.

6.3. Parameter Estimation

Manning's "n" values were entered into the hydraulic model to represent the values that were documented as part of the field reconnaissance, orthophotography, and engineering judgment. Table 4 provides the "n" values that were used in the HEC-RAS model for the study reach.

Table 4 – Manning's "n" Values

Study Stream Name	Channel n-value	Overbank n-value
Arroyo de los Montoyas	0.03	0.05

Expansion and contraction loss coefficients were applied to all crossing structures within the HEC-RAS model to account for the additional energy losses. In cases where a structure was overtopped by a flood event, expansion and contraction loss coefficients were set to the default values of 0.1 and 0.3. The crossing structure located along the study reach consisted of a concrete box culvert with concrete wing walls. Expansion and contraction loss coefficients were applied between cross-sections to account for losses to the changing width of the channel. Table 5 provides the loss coefficients that were used in the HEC-RAS model.

Table 5 – Expansion and Contraction Coefficients

Structure	Contraction Loss Coefficient	Expansion Loss Coefficient
Cross-Sections	0.1	0.3
Bridge/Culvert (not overtopped)	0.3	0.5
Culvert (significantly narrower than channel width)	0.6	0.8

6.4. Modeling Considerations

All models prepared for FEMA assume that all structures are maintained and have no obstructions.

The location of toe of dam is based on field reconnaissance because it does not show up on the orthophotos or the contours since it is too new.

7. Floodplain Delineation

HEC-RAS results from the hydraulic modeling were exported to GIS format. These results allow HEC-GeoRAS to automate the floodplain delineation with the use of the previously created terrain model. The resulting floodplain boundaries are in agreement with the modeling results for the study reach.

The results of this study are required to tie into the preliminary Special Flood Hazard Areas (SFHA) of greater study detail. The study reach in Sandoval County ties into the preliminary Zone AE floodplain at the downstream limit of study. Construction is nearly completed on the Montoyas Arroyo Sportsplex Dam at the upstream study limit.

To ensure consistency between the preliminary maps and this study, the floodplain boundaries generated in this study were adjusted to tie into the floodplain boundaries developed as part of the 2006 Countywide FIRM and FIS Update for Sandoval County. MAPVI was unable to tie in to the upstream floodplain along this reach due to the age of the effective model and the new construction of the dam. A “Limit of Study” line was drawn at the upstream and downstream limits of the Arroyo de los Montoyas floodplain to designate where it ties into the effective floodplain.

8. Exceptions

I. Because the 1-percent-annual-chance flood discharge was obtained from SSCAFCA, and subsequently, no new hydrologic analyses were performed, MAPVI will not be providing the S_Hydrobasin, S_Hydrolink, or the S_HydroNode spatial files.

II. MAPVI uses ESRI ArcMap version 9.2. For compatibility reasons, MAPVI will not be providing a Georeferenced database.

III. Field reconnaissance data was collected for the structure at Broadmoor Drive, however, the study stream was later truncated upstream of Broadmoor Drive. The field reconnaissance data is included in Appendix A, but was not used in the hydraulic modeling of the study stream.

I. Lookup reference fields (LID fields) were replaced with the final data field that the LID referenced. The following is a list of data fields that were impacted:

1. S_XS Spatial file
    a. STREAM_STN from the specification is equivalent to STRM_STA
    b. WTR_NM from the specifications is equivalent to STRM_NAM
2. S_FLD_HAZ_AR Spatial file
    a. ZONE_LID from the specification is equivalent to FLD_ZONE
    b. V_DATM_LID from the specification is equivalent to V_DATUM
    c. LEN_LID from the specification is equivalent to LEN_UNIT
    d. VEL_LID from the specification is equivalent to VEL_UNIT
3. S_FLD_HAZ_LN Spatial file
    a. LN_LID from the specification is equivalent to LN_TYP
4. S_WTR_LN Spatial file
    a. WTR_NM from the specification is equivalent to STREAM

IV. In the S_XS spatial file, the TOR cross-sections (see TYPE field) were developed in Geo-RAS 4.1 (USACE, 2005) to create the HEC-RAS structure.

V. When calculating top widths, HEC-RAS does not account for braided stream morphology and therefore, underestimates the total top width. In a braided stream cross-section, HEC-RAS adds the top widths of the individual channels instead of computing the width of the entire channel.

VI. The flood recovery data provided as part of this study are outside the scope of the FEMA Map Modernization Program. As directed by FEMA, the computed flood elevations are provided in the Floodplain Elevation Data Table.

9. Conclusions

The floodplain boundaries generated in this study were generally narrower than the preliminary floodplain boundaries. Variations in the floodplain boundaries occurred because the newly constructed Montoyas Arroyo Sportsplex Dam has altered the hydrology of the stream by reducing the 1-percent-annual-chance peak flow. Changes in land use have also affected the floodplain boundaries.

9.1. Result Locations

The database tables and spatial files provided as part of this submittal can be found in digital format in Appendix G of this TSDN. The flood recovery data developed as part of this study falls outside of FEMA's normal flood hazard mapping operations, therefore many of the spatial files and database files required for a normal FEMA flood hazard mapping submittal are not included in this submittal. The database tables and spatial files included in this submittal were developed in accordance with the *G&S*; Appendix L (dated April 2004) and any exceptions are listed in the Exceptions section.

10. References

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New Mexico State Highway & Transportation Department. *Drainage Design Criteria*. 1995.

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U.S. Army Corps of Engineers (USACE). *Hydrologic Engineering Center's Geospatial River Analysis System (HEC-GeoRAS) User's Manua*l and software version 4.1. Davis, CA. September 2005.

USACE. *Hydrologic Engineering Center's River Analysis System (HEC-RAS) User's Manual* and software version 3.1.3. Davis, CA. April 2004.

Watershed Concepts. *Survey Manual* Version 3.7 and Watershed Information System (WISE) software, Version 2.0.9 SP2. Roanoke, VA. July 2004.

Figure 1. Study Stream Reaches
Sandoval County, NM